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ABSTRACT

In these conference proceedings on employing workers with physical disabilities, an overview describes the scope of the need for modifying worksites. It emphasizes the need for a functional evaluation of the person's capabilities and an understanding of individual differences which must be considered in the design of assistive devices. Also described are disincentives to finding a job or hiring a worker with a disability. "The Process of Designing for the Handicapped Worker" outlines steps in the job design process, especially task analysis of jobs and functional analysis of disabilities. "The Rehabilitation Process" describes three types of rehabilitation situations: an acute catastrophic injury, a developmental disability, and an industrial injury. "The Process of Accommodation" discusses modifications to the job, equipment, and facilities that will help an individual's performance in the areas of lifting and carrying, manual tasks, mobility, seating, hearing, and seeing. "Job Accommodation Resources" provides information on: (1) community-based resources such as ergonomists, vocational rehabilitation agencies, medical practitioners, etc.; and (2) resources for technical redesign and engineering, such as research centers and information systems. The paper concludes with a directory of resources. (JDD)

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DESIGNING JOBS

For Handicapped Workers

The President's Committee on Employment of the Handicapped

RESNA

Association for the Advancement of Rehabilitation Technology

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Joint Seminar

Designing Jobs For Handicapped Workers

CONFERENCE PROCEEDINGS

Chicago, Illinois

December 1985

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Designing Jobs For Handicapped Workers

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This document represents the fourth publication to result from joint Education and Publications Committee effort, and is part of a continuing program of RESNA--the Association for the Advancement of Rehabilitation Technology, to compile and make available practical information on advances in rehabilitation technology.

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INTRODUCTION

This publication represents a collaborative project by a number of individuals around the country pooling their efforts to facilitate the employment of people with disabilities. The employment of workers with disabilities adds to the overall human resources available to this country to continue to advance economic productivity and the maximization of human potential. Worksite accommodations are an important component of the overall effort to bring more people with disabilities into the employment environment.

The Worksite Committee of the President's Committee on Employment of the Handicapped was established in 1983 to encourage employers, engineers, personnel administrators and others to employ and accommodate workers with disabilities. This publication represents just one of many activities of the Committee to realize this goal.

The Committee is made up of volunteers and the work on this and other Committee functions represents an extra effort on the part of the members. Since the Committee membership represents a diverse group of professions, a unique blending of perspectives is presented. This publication should be a valuable resource to professionals and others interested in worksite accommodations.

This publication was originally published as a proceedings in support of a seminar on "Designing Jobs for Handicapped Workers" organized by the Worksite Committee in collaboration with the Institute of Industrial Engineers. The committee members who contributed to the writing of this publication include David Alexander, Jack Clarcq, Deborah Davis, Barbara Portnoy, John Leslie, Arthur Longmate, Gerald Miller, James Mueller, John Priest, and Gerald Weisman.

In an effort to make the information on accommodations more widely available, the Association for the Advancement of Rehabilitation Technology is publishing this document. Appreciation is extended to the Publications Committee and those in the RESNA central office who made the publication of this document possible.

David Alexander
Deborah Davis
Gerald Weisman

Worksite Modification

An Overview

Section 1

WORKSITE MODIFICATION: AN OVERVIEW

Professionals working in the area of worksite modification say somewhat whimsically that their clients come "in groups of one". This may be a trite expression but there is a large degree of truth in it. Contrary to the traditional medical role of rehabilitation engineering, designing for productivity at the worksite involves more than a medical diagnosis. A functional description of the task, compared with the person's capability, demand that each individual situation be analyzed as a separate problem with a unique set of knowns and unknowns.

The scope of the problem related to the productive employment of individuals with disabilities in the United States is staggering, both in economic and human terms. The U.S. Department of Health and Human Services (DHHS) reported in 1981 that approximately 17 million persons of workforce age suffer some form of physical impairment. These individuals between the ages of 17 and 64 have disabilities which preclude or limit their vocational opportunities. In 1980, DHHS reported that approximately 10.7 million adults are severely limited and thus unable to work altogether or to work regularly. On a more subjective basis, the American Coalition of Citizens with Disability in 1982 reported that more than half of the working age disabled adults who could work are jobless.

Inability or reduced ability to work, therefore, is a problem that faces millions of Americans with disabilities. The cost related to vocational disability, while extremely difficult to allocate to specific disability groups is, nevertheless, immense. The Social Security Bulletin in April, 1982, reported that 2,772,000 working age individuals were receiving Old-Age Survivors and Disability Insurance benefits. The average benefit paid to these individuals on a monthly basis was $412.34. By a simple multiplication of the number of people by the monthly payment, an amount of $1.2 billion per month is obtained. While it is admitted that not all persons falling into this particular category could return to work through the medium of rehabilitation engineering, even if a conservative estimate of 10% is utilized, a cost saving of $1.2 million per month could possibly result.

Even though environmental modification to achieve independent living has value in its own right, research indicates that being able to live in one's own home contributes significantly to vocational success. The ability to access adequate public transportation also is an extremely important element. Therefore, it is difficult to confront the elements of <u>home and worksite modification</u> in a vacuum. Failure in one area might preclude success in another. The benefits accruing to the social/economic system from success are significant.

Problems affecting the provision of an effective service delivery system for worksite modification through the interaction of rehabilitation engineering are real and challenging. But, to

the rehabilitation engineer, they only offer a professional opportunity to be analyzed and ultimately solved. The difficulties associated with worksite modification which challenge the rehabilitation engineer on a day-to-day basis may not always be technical. In many cases, they are social, economical/political in nature and limit the extent to which technology can be applied to the problems confronting people with disabilities. All problems may not be solved by technology but they all benefit from an application of an analytical, systems approach.

In dealing with worksite modification, it is mandatory that a functional evaluation be made of the person's capability, and the person's profile matched with the tasks of the job. The Wichita Rehabilitation Engineering Center (REC) has developed the Available Motions Inventory (AMI) to perform a functional evaluation of potential workers in blue collar jobs. While this evaluation hardware is quite sophisticated and is being refined daily, there are still gaps in the general area of functional evaluation of disability. Job analysis in white collar environments has been performed by the Job Development Laboratory which which was then at George Washington University. Even though much has been done in the field, much remains to be done to quantify the effects of disability into logical, pragmatic terms which can be utilized in work station modification.

In many cases, it is quite simple to design an adaptive device to allow the person who has experienced trauma to return to his/her old job. These individuals also have the social/educational backgrounds to effectively seek employment. They lack the physical skills, as a result of the disability, to be productive at their prior places of employment. The person with a disability who has a proven employment track record and an educational background in a marketable skill presents a different problem from the person with a congenital disability who has little or no social/educational background. The practitioner in the field must be aware of the differences between the person disabled through trauma and the person who is disabled from birth. The individual with a congenital disability, in many instances, has lived in a sheltered environment and may have limited educational background. It is not unusual to see such an individual allowed to pass through schools without any real achievement. This individual requires a maturation process in order to become productive on the job. Even though the person disabled through trauma may possess psychological and emotional problems associated with his/her disability, at least this individual usually has had work experience. The person with congenital disability usually has none. The point of all this discussion is that the problems confronting various disabled populations are different. Some may be entirely technical, some may be technical, educational, psychological, emotional, or any combination of these. The successful rehabilitation engineer should recognize these individual differences and call on the members of a comprehensive rehabilitation team to assist in dealing with those beyond his realm of technical expertise.

A very real problem associated with employment of persons who are severely disabled is the welfare system. Economic disincentives inherent in welfare systems are a primary barrier to successful and productive placement. In many instances, it is more economical for the person to remain on the welfare rolls than to seek employment. The concept of total dependence or total independence in this country does not encourage the person who is severely disabled to seek employment. In fact, it encourages the opposite. A system of economic support/subsidy based upon elements of productivity in the work environment would go a long way to ensure that individuals who are severely disabled can achieve and, more importantly, maintain the same economic status as their able-bodied counterparts.

At the present time, there is little or no motivation on the part of business/industry to employ the person who is severely physically/mentally disabled. As alluded to earlier, the person who has experienced past trauma and who has a sophisticated social/educational background and a marketable skill can be readily employed with the appropriate adaptation. The person who is severely disabled from birth, without a salable/marketable skill provides a much greater challenge since the employer is largely dealing with an unknown quantity. Tax credit incentives to allow industry to provide aide and attendant care and/or professional staff inhouse to deal with problems of disability, are a must if significant numbers of people with disabilities are to be employed. Several large corporations, such as du Pont, IBM, AT&T, and Sears have outstanding records of employing people with disabilities. This is commendable; however, the practice must be extended to mainstream industry if the majority of persons with disabilities are to reach the employment goal.

In order to assure productive employment, the satellite systems that support employment must be in place and must be effective. Adequate transportation to and from work is necessary to facilitate success on the job. For the person who is severely disabled, aide and attendant care may need to be provided at the work station in order to serve basic human needs. Accessible housing and community recreation are both important requisites for meaningful employment. One does not work for money, one works for what money will buy. The person with a disability who does not have appropriate housing and the recreational opportunities to spend his/her leisure time is not a whole person. This creates emotional problems resulting in unhappiness at home which, unfortunately, translates to unhappiness on the job. An unhappy employee is not a productive employee.

Up to now, the problems confronting individuals who are severely physically disabled have been examined. The successful rehabilitation engineer must realize that the sheltered work centers of this country employ a tremendous number of persons who are mentally ill/mentally retarded. The broad application of rehabilitation engineering to vocational problems should not only concern those persons who are physically disabled. In many cases, worksite modifications associated with physical disability

can be effective for mental retardation/mental disability. The mere act of making a job simpler and/or easier to perform allows the individual who is mentally retarded to be productive. Many, if not most, work centers are under-capitalized and are not staffed by technical persons. Literally tens of thousands of persons who are mentally disabled can be productively employed through the interaction of the media of rehabilitation engineering. This fact must not be overlooked or the rehabilitation engineering profession will be doing a great disservice to an important segment of the disabled population.

The problems are significant. Everything, however, is not all gloom and doom. The application of rehabilitation engineering to the problems confronting people at work is relatively new and, therefore, exciting. If the profession is to be successful in the future, the definition of rehabilitation engineering must be broadened beyond that of the medical model. A system of funding rehabilitation engineering service must be developed by traditional and non-traditional funding agencies. The professional status associated with vocational rehabilitation engineering must be as great as that currently associated with medicine. Tax credit systems must provide economic incentives for employers to hire people who are severely disabled, especially those congenitally disabled. General guidelines for adaptive devices must be developed, with general categories of functional disabilities and tasks associated with families of jobs. Consumer input should be obtained on a more systematized basis since many people with disabilities have developed quite sophisticated technical solutions to their problems on the job.

The word "handicapped" is a relative term. The rehabilitation engineer's goal is productivity in its broadest sense. Productive "disabled" people are not "handicapped." They have deafeated their medical condition and enhanced their human condition.

The Process of Designing for the Handicapped Worker

Section 2

THE PROCESS OF DESIGNING FOR THE HANDICAPPED WORKER

Designing to accommodate the special needs of workers with disabilities is similar to other design processes an engineer might follow. In particular, the design is similar to that used to match the person to a job, and to perform job redesign. By following a specific process, the engineer can ensure that all important aspects of design are covered, and that the important criteria for a successful design are met.

It is the intent of this discussion to provide a proven method for the design of jobs for workers who are disabled. This process has been successfully used in many organizations, by both experienced and novice designers. The process is first outlined in four general steps. Following that are sections on the two critical aspects of designing jobs for workers with disabilities - task analysis of jobs and functional analysis of disabilities. Next, a series of good practices is presented to aid the engineer in the design effort. Finally, some examples of accommodations are provided.

The Job Design Process

The job design process to accommodate a worker with a disability is straight forward. That process is illustrated in Figure 1 and in the narrative which follows (1,2).

Step One: Select the Job

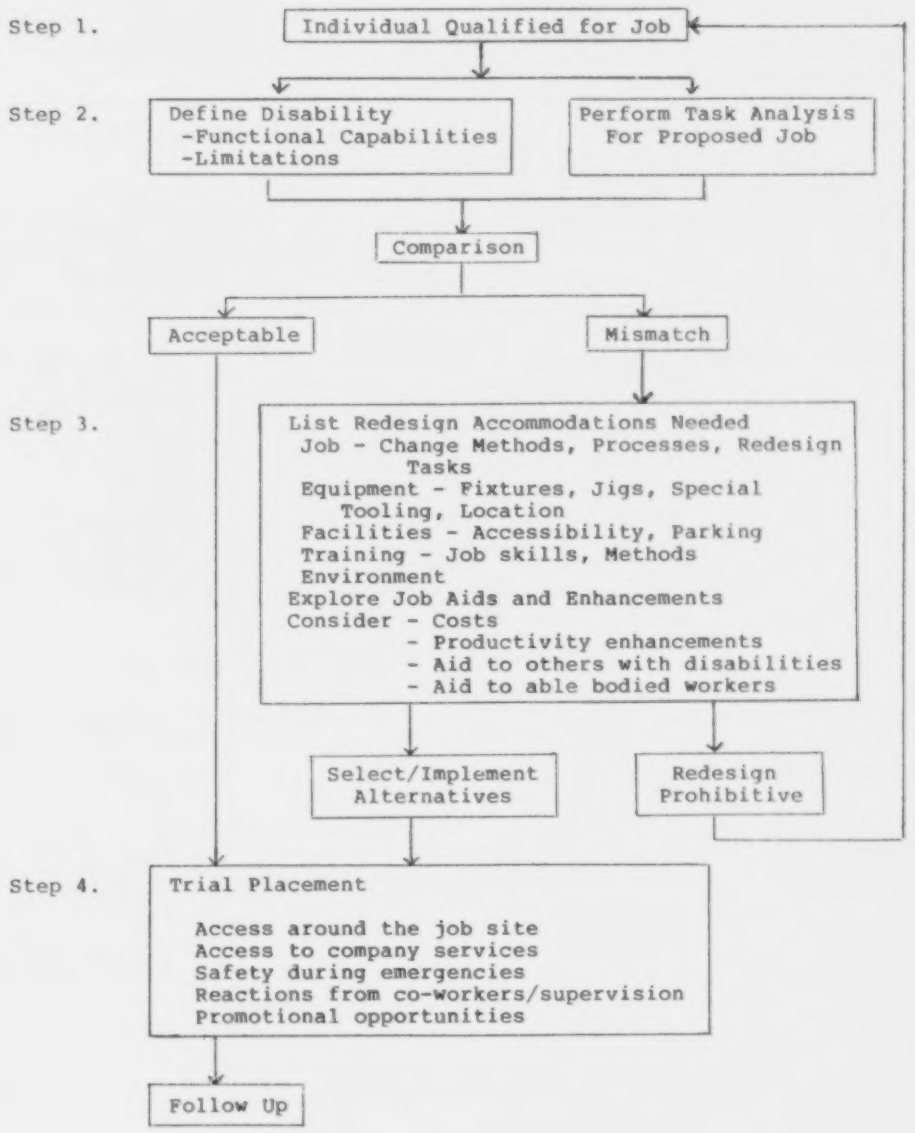
With the employment process, the first step is to select a job or jobs that are available to the individual. The jobs may be entry level jobs that all people go through, or the job the person had before the onset of the disability. The major criterion at this point is to ensure that the person is or can be qualified for the job through training, job skills and/or job redesign. If the person is not and will not be qualified for any available jobs, then the process ends just like any other employment process.

Step Two: Task Analysis

The next step in the process is to assess both the job/task requirements and the abilities of the individual. This can be performed at various levels, from overall job description to detailed task analysis. Although detailed task analysis is regularly done by industrial engineers, and information on this process is generally available, a brief description of task analysis is provided in the next section. While the assessment of the individual's abilities can be made by most medical and/or rehabilitation personnel, that process is also briefly covered. Medical and rehabilitation personnel are usually available locally, and in many cases can provide support. The individual with a disability can also contribute to the assessment of the disability.

Figure 1

THE PROCESS FOR JOB ACCOMMODATION



This step of the process will reveal whether or not the individual can do a particular job and the level of redesign necessary. It is not uncommon to find that there are no limiting factors; but if there are, then continue the process.

It may be appropriate here to examine future jobs and promotional opportunities for the individual. The same process, task analysis and assessment of the person's abilities, can reveal any possible problems that might occur in the future.

Step Three: Accommodation Possibilities

There are generally four types of accommodations to be considered. The four types are:

* Facilities and Equipment Design
* Job Design
* Training
* On-going Support

Each of these items is discussed in more detail in the following paragraphs.

Facilities and equipment design cover the "hardware design" aspects, such as the need for jigs, fixtures, or special tooling. Equipment may need to be modified or adapted in some way, or special equipment may be purchased. Facilities may require modification to provide access to the workplace or access within the workplace.

Job design covers the "software design" aspects such as the removal of one particularly difficult task from a whole job, flexible work time, and changed work methods or processes. Usually, job designs require little or no cost.

Training changes the individual rather than the equipment/facilities or the job. Training may provide new or expanded job skills, so that new work duties can be assumed. Training of the individual may open the door to new job opportunities, and while normally done before employment, it may be the best solution to employment options.

On-going support is the final consideration. It may be required regardless of whether the individual can do the job or not. Support may be needed in the form of an attendant to assist in reading for the visually impaired, in translating during classes for the hearing impaired, or in assistance with transportation. In some cases, assistance is always provided, although usually it is required infrequently. Assistance may be provided by line supervision, or by others in the work force. Training of the work group on the special needs of someone with a disability is usually beneficial to both the individual and the work group.

During the exploration of these modifications and changes in the work area and to the job, the employer must always consider

the costs involved and possibilities for improved productivity. The changes may also aid others with disabilities and/or able-bodied workers.

If the possible changes should prove to be prohibitive because of costs or other factors such as space limitations, then another job is selected and the process begins again. Job redesign is not an exact science and sometimes requires trial and error.

Step Four: Trial Placement

At this point, a match between the individual's capabilities and the requirements of a job has been found. Other factors such as accessibility to the worksite, emergency considerations, and promotional opportunities have all been explored and found to be satisfactory.

A trial placement should be arranged and conducted. The trial placement will allow the individual to fully experience the job on a regular basis. At the same time, work output can be examined to ensure that the job is performed satisfactorily. Regular follow-ups can be conducted, and further modifications made as necessary. Initially, it is important to follow-up periodically to ensure success on the job.

Task Analysis of Jobs

Task analysis is a systematic method of identifying and evaluating job taks requirements and comparing these to human capabilities. The format for a task analysis usually consists of a listing of job tasks and a description of the various requirements for the task. The level of detail for each job task can range from general description to very detailed physiological requirements. An example of a typical task analysis format is shown in Figure 2.

To provide the information basis for accommodating workers with disabilities, the task analysis format should:

* Identify job opportunities.
* Provide physiological and social job requirements.
* Include accommodation information for workplace modification.
* Identify potential problems.
* Document training requirements.

To successfully perform a task analysis the job should be described in separate, identifiable units of work. Each of these units is then analyzed for job requirements. As each task is identified, these requirements are compared to the capabilities of an individual with a disability or disabled populations. If there are tasks which cannot be performed, the industrial engineer can possibly redesign or modify the job task, utilizing traditional redesign methods.

Figure 2

Example of Task Analysis Format

Job Title: Printed Wiring Board Component Assembly

Job Classification: Electronic Assembler

Production Line: Power Supply Board

Job Description: Insert components into the power supply board according to procedure. Restock operation as necessary.

Subtask	Required Action	Time (Min.)	Work Station	Skill Level
Identify component for insertion	Identify next component for insertion and its location by reading procedure	.15	Assembly Line	Low Reading Level
Place component on board	Reach to bin for component and place on board	.20	Assembly Line	Reach Distance 12" to 28"
Verify proper location on board	Verify location by checking procedure	.10	Assembly Line	Low Reading Level

Problems with utilizing traditional methods of task analysis for workers with disabilities have concerned their emphasis on job performance and time standards. In addition, these methods have not addressed non-production related considerations for the worker with a disability, such as physical barriers, communication requirements, and environmental conditions. As a result, several job analysis methods have been developed to specifically address the needs of workers with disabilities (3,4).

Functional Assessment

"Functional assessment" is a broad term used by human service professionals to describe a person's abilities and behaviors for performance in various life activities. The West Virginia Rehabilitation Research and Training Center (5) proposed a working definition for functional assessment as "an organized and comprehensive evaluation of a person's capacities, behaviors, and limitations which are relevant to his or her vocational potential" (p. 5). For reference here, functional assessment will refer to the evaluation of vocational performance capacity.

Rehabilitation professionals have employed functional assessment techniques for many years, but have found that the work frequently presents more questions than answers. For example, should a person who is known to have limitations in reach capacity, coordination and manual dexterity be evaluated against norms for able bodied workers in an industrial setting? While there is no easy answer to many concerns, the progress in this field of work is exciting. Researchers in medicine, engineering, education, and vocational rehabilitation are identifying assessment limitations, and initiating new activities to better serve the person with a disabling condition. The increasing demand of consumers and the raised consciousness of persons working in the rehabilitation field require that the assessment procedures address not only the capacities of the individual, but also the possible limitations of the environment. This is a dramatic switch. Historically, medical science diagnosed an individual with a "condition" for which a set of symptoms and limitations were described. With consideration of the environment as a limiting factor, the field of vocational assessment has expanded tremendously. If the job demands can be specified, alternative strategies for vocational rehabilitation and enhancement of performance can be considered.

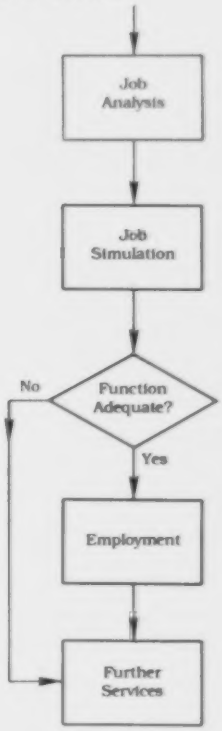
The goals of rehabilitation include the return of the person into society with an opportunity to participate to the fullest extent socially, personally and vocationally. The individual is entitled to a thorough assessment of functional capacity, not just diagnostic labels of medical conditions, aptitude and personality style. Thus, the environmental demands for performance must be considered. If a narrow door is the only obstacle in returning a computer programmer who uses a wheelchair to the workplace, isn't the door the problem and not the person? Figure 3 illustrates the general concerns involved in functional assessment.

Figure 3

Functional Assessment of the Job

Assessment of Specific Functions

- Physical Demands
- Time Frames
- Physical Tolerances
- Environmental Characteristics
- Behavioral Aspects



Source: Rehabilitation Institute of Chicago, 1981

During this presentation we will briefly review several functional assessment techniques. Figure 4 provides a listing of the dimensions involved in functional assessment. Examples of such evaluations include the Functional Assessment Inventory, the Available Motions Inventory, and the Westwork Comprehensive Functional Capacity Evaluation. Other types of functional assessments include a broad range of work sample evaluations, aptitude assessments, and motor coordination and dexterity assessments commonly seen in a rehabilitation setting. The information obtained from these assessments provides data for the client (employee), the rehabilitation professional and the employer as they begin to explore job placement and possible job modifications. The functional assessment of the individual is the initial phase of vocational rehabilitation and is not complete without assessment of the job, the job demands and the total work environment. In general, the more specific the job information, the more specific information the functional assessment can provide.

Good Practices

There are a number of things the employing organization can do to help ensure success when hiring someone with a disability. Some of the more common actions are listed below (6).

Involve the newly hired person in decisions on accommodations. Ask the person what accommodations would help. Frequently, the person has made a successful accommodation at home or is aware of someone else who has. The person with the disability may be the best source of information regarding practical accommodations.

Develop at least one staff person with special skills in the placement of people with disabilities. This person will soon understand the placement and accommodation process and will become quite efficient in working with the process. At the same time, that specialist will be able to identify jobs which require little or no modification. Ideas on job accommodations should be collected in one spot for easy use and reference. Larger employers may choose to utilize one of the staff groups such as personnel, ergonomics, equal employment or industrial engineering for this function.

Resources should be collected in advance and catalogued. Ample resources for simple accommodations are available through a number of sources. Some of these are listed in the final section of this report. Contacts can also be made with local agencies that work with disabilities. Often, their library can supplement your own.

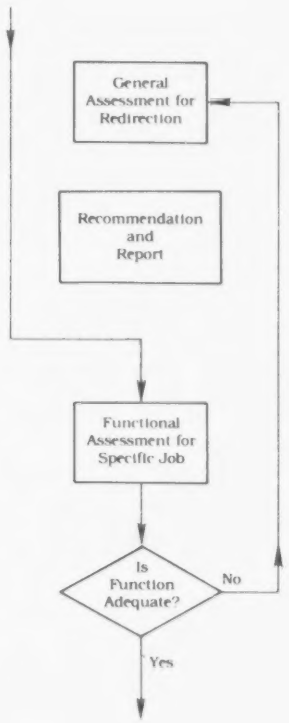
Hold pre-employment discussions/orientations with others in the work group and with supervisors. They need to know what to expect from this new worker; and this will provide a chance to answer questions they may have. It will also provide an opportunity to let them know your on-the-job expectations of the per-

Figure 4

Functional Assessment of the Individual

Functional Assessment

- Aptitude Investigation
- Dictionary of Occupational Titles
- General Learning Ability
- Verbal Ability
- Numerical Ability
- Spatial Aptitude
- Form Perception
- Clerical Perception
- Motor Coordination
- Finger Dexterity
- Manual Dexterity
- Eye Hand Foot Coordination
- Color Perception



Source: Rehabilitation Institute of Chicago, 1984

son with a disability. People may feel they need to help the individual in ways that are not productive for either party, like assisting with work quotas.

Managers, supervisors and co-workers should be encouraged to look for ways to improve efficiency on the job, and to identify tasks or work methods where changes can be made beneficially.

Share successful accommodation experiences within the organization and with other organizations. Unsuccessful accommodations can provide a strong learning experience, and should also be discussed. Local, regional and state organizations can benefit from your experiences; in a like manner, you can benefit from the experiences of others.

Seek advice and assistance from local private and public agencies which are familiar with people with disabilities. Their experiences are usually broader, better, and more successful than your initial efforts might be. They often will provide assistance at little or no cost.

When possible, set the tone of strong top management commitment to the accommodation of workers with disabilities. At the same time, realize that top management commitment may only come through success. Several effective placements, and the associated cost saving in disability payments, may prove to be the strongest builder of commitment.

Accommodations in Practice

A "job accommodation" is the change to a worksite or job function to fit the qualified person with a disability. It need not be elaborate, expensive or burdensome. Employers should think in terms of reasonable and common sense solutions to making the job site and job functions work.

Job accommodation takes many forms. It may be only one change, or it may be a series of changes and adaptations. It really depends on the nature of the business, the plant or office setting, and primarily, the individual worker who is disabled.

Many experienced employers find additional benefits from job accommodation: redesigned job tasks frequently are safer and more efficient for all workers; modifications to a building, such as easily operated doors, benefit nondisabled workers as well as workers with disabilities; the already-qualified worker with a disability becomes more valuable and productive for the employer (6).

Commonly Used Accommodations

Some commonly used accommodations are identified in the following list (6).

* Building ramps, widening doors and aisles, and modifying elevators and washrooms.

* Providing convenient parking and/or carpool or van transportation.
* Providing flexible working hours, rest periods or provisions to work at home.
* Adjusting the work space by lowering workbenches or providing a private office.
* Adjusting the work area by moving a job to a ground floor location.
* Providing special assistance such as readers for workers who are blind, sign language interpreters and TTY equipment for workers who are deaf, talking calculators and reading machines.

Newer Accommodations

Computer technology is rapidly developing accommodations for some of the more severe disabilities. A few examples are shown below (7).

* Braille word processing systems that allow a person who is blind to compose, edit, and print out a letter or report for a sighted person to read.
* Scanning devices that instantly convert printed or typed material into either synthetic speech or raised letters for the person who is blind.
* TTYs and electronic mail that enable workers who are deaf to communicate over telephone lines.
* Voice-recognition equipment that allows a person with paralysis to control the environment - turn on lights and television - by merely stating a command.
* A legal research database system for lawyers and law students who are visually impaired.

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The Rehabilitation Process

Section 3

THE REHABILITATION PROCESS

The term "rehabilitation" means something different to each person. For some, it conjures up images of a wheelchair user, unable to propel himself or herself, unable possibly to speak or to take care of personal needs. For others, it means being sent to a sheltered workshop to learn to work again in a more limited capacity. It seems that even rehabilitation specialists and researchers are unable to agree on terminology to describe a person with a disability. For example, a recent publication of the World Health Organization (1) attempted to clarify terms for utilization by researchers, educators, and practitioners. The publication addressed definitions for three commonly used terms: impairment--"any loss or abnormality of psychological, physiological, or anatomical structure or function" (p. 27); disability--"any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being" (p. 28); and handicap--"a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual" (p. 29). Perhaps these definitions will receive some uniform acceptance and permit greater understanding of "disability" language.

Although there continues to be a lack of clarity in a number of areas in rehabilitation, the goal is usually thought of as returning the individual with a disability or handicap to a stated lifestyle at home, in the community, and in the work place. The rehabilitation process, therefore, is designed to maximize the continued functioning of the person and brings together a variety of professionals to assist in the restoration of function and the development of compensating systems. Also, in many situations, rehabilitation is used synonymously with habilitation. For some persons with disabilities, the process is one of learning or acquiring new behaviors and techniques rather than relearning. In this presentation rehabilitation will be used to include both types of activities.

The rehabilitation process is usually envisioned as beginning toward the end of the acute medical care process. Often the first phase of the process is the evaluation of residual strengths and limitations in order to assist the individual in determining rehabilitation goals. Evaluation involves a variety of professionals--physicians, nurses, physical therapists, occupational therapists, vocational evaluators, psychologists, social workers, and rehabilitation counselors may be included. These specialists assist the individual in the identification of assets and limitations, the development of immediate and long-range goals, and compensating techniques/systems for the development of programs to enter or return to home, family, and work. These goals address medical, educational, vocational, and adjustment services needed by the individual.

The second phase of the rehabilitation process is frequently the actual treatment which has been outlined in the evaluation phase. The person may enter a rehabilitation hospital or facility to work on improved physical or mental functioning. It may be necessary to enroll in a program such as mobility and orientation training for a person who is blinded. These and other services may also be combined with a vocational training program or education in a college or university. Rehabilitation treatment programs may cover a wide range of services and encompass programs not normally viewed as rehabilitative in nature.

The third phase of the process is the movement from formal treatment to home, work and other life activities. Most rehabilitation organizations provide assistance in working with families to facilitate the return to the home setting. Also, assistance in job placement and initial adjustment to the work setting is frequently provided. Rehabilitation organizations also work with community agencies and programs to facilitate their use by individuals who are disabled. Assistance with return to work, family and community are frequently provided to assure that the environment "understands" and accommodates the individual as well as helping the individual to integrate with the environment. Job accommodation usually occurs during this third phase.

During this session three types of rehabilitation situations will be presented: an acute catastrophic injury such as spinal cord injury; a process commonly experienced by a person with a developmental disability; and a process representative of the industrially injured individual experiencing an impairment such as a back or traumatic hand injury. Perhaps you will attain a new image of the word "rehabilitation", as well as a reasonable understanding of the rehabilitation process.

Acute Catastrophic Injuries

The individual experiencing an acute catastrophic injury usually requires an intensive medical and rehabilitation program. The injury often occurs as a result of an automobile accident, at least in our society, and requires intensive acute care from a variety of physicians and health care professionals. When the spinal cord is severed, loss of physical functioning occurs in those areas below the level of injury. Therefore, we encounter people with this disability who have been labeled as having paraplegia, the loss of functioning of lower extremities, or quadriplegia, the loss of functioning of all four extremities. These functional limitations obviously affect many of the usual activities we engage in. The mobility impairments resulting from spinal cord injury require considerable adaptation.

The development of motorized wheelchairs which can be operated with a variety of switches--breath, eye lid, hand--provide enhanced mobility. Rehabilitation services for a person with a spinal cord injury frequently involve attention to personal care, including maintenance of bowel and bladder functions.

The psychological and social implications of spinal cord injury are often important treatment concerns. The individual may have to rely on others for many ordinary functions such as dressing and eating.

However, with the advent of technology in the mobility area, and with medical care innovations, many individuals with spinal cord injuries are able to function effectively in employment situations. Examples of employment are legion, running the course from computer experts to attorneys. The individual with paraplegia has considerably less functional loss and, as a result, may be able to continue many activities not normally thought possible--you have probably heard of wheelchair basketball and, if you saw the last Olympics, you may have seen many individuals in wheelchairs participating in races. There are a variety of sports wheelchairs currently on the market in response to the demand in this area.

Engineers can frequently play a vital role in the design of technology to facilitate the employment of workers with spinal cord injuries. Job redesign and adaptive devices have already enabled many persons with such injuries to return to or engage in full time, productive employment.

Developmental Disabilities

The individual with a developmental disability has a different experience in rehabilitation services. These disabilities by definition occur at birth or an early age and continue throughout life. One of the most common developmental disabilities is mental retardation defined by the American Association on Mental Deficiency as "significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior, and manifested during the developmental period" (1). This means intellectual functioning which is two or more standard deviations below the mean on general intelligence tests coupled with adaptive behavior problems.

The individual who is mentally retarded will normally experience special education services and may have participated in a variety of programming options during the school years. Schools and rehabilitation organizations have used work-study and career education programs during secondary education. The work-study programs involve participation in the school setting for one-half day coupled with the remainder of the day in a work setting. These programs provide opportunities for work experience and work-related skill development in actual work settings. Career education programs are more broadly based and provide instruction and experiences in work and activities of daily living.

Considerable attention has been devoted to the development of vocational training programs to teach individuals with mental retardation essential employment skills. Some research has shown that these individuals can acquire more complex skills than typi-

cally thought possible in the past. Many persons with mental retardation have entered the work force and have proven they have valuable vocational skills. In some instances, the initial orientation and training for employment require additional attention, but after skill acquisition and orientation to the work place, the individuals are able to function effectively. Frequently, the accommodation assistance required for workers with mental retardation has been the use of behavioral techniques to develop skill and knowledge acquisition, rather than engineering for job redesign.

Industrial Injuries

The person who experiences an industrial injury requires yet another type of rehabilitation. Injuries to the hands are commonplace and often considerably affect the worker's ability to return to previously held jobs. The injury frequently results in the individual being away from work for a period of time, and may also involve compensation settlements. As is the case in any other disability incurred as an adult, the person usually has a pre-injury period of work experience and exposure to work settings. The individual may experience considerable recovery from lost physical functioning over time, and may be able to return to the former job.

Also, the injury may necessitate a change in employment, requiring some accommodations through job redesign. Depending on the severity of injury or type of employment, the worker may be able to return to work with assistance from medical specialists. However, should retraining and psychological adjustment be necessary, rehabilitation specialists may need to assist in the identification of employment opportunities and provide counseling. In the case of industrial injury, the problems are primarily facilitating the return to work or the selection of other opportunities, perhaps in the same employment setting.

The industrial engineer and other engineering specialists may be of assistance to the worker experiencing industrial injury through a variety of job redesign techniques applicable to any other form of disability.

Summary

This has been a brief overview of the rehabilitation process, highlighting evaluation, treatment and job placement aspects. Three types of disabilities have been used to illustrate the variability in the process. Evaluation applied to developmental disabilities is quite different from the process for a person experiencing a spinal cord injury. Treatment varies across different types of disabilities, and the considerations in job placement and job accommodations are also different. In the case of the person with a mobility impairment, accessibility issues are very important. Being able to enter a building on a ramp, access restroom facilities, and get into the work station are all essential for a person in a wheelchair to work. However,

for the person with mental retardation, the manner in which training and education at the worksite occurs may be the important factor in job success. The person with an industrial injury is primarily working toward returning to the worksite. These and other disabilities present a variety of challenges to the person with the disability, and to those professionals who are attempting to help them access and engage in productive work. Job accommodations assistance has played a particularly important role in this process and, with more extensive application of engineering skills, many more workers with disabilities will be able to enter the work force.

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The Process of Accommodation

Section 4

ACCOMMODATIONS

Accommodations may take many forms such as adapting the work environment, changing the location of the job, retraining the worker, selectively placing the worker where no accommodation is needed, providing transportation or special equipment or aides, redesigning the worker's job, or reorienting or providing special training to supervisors or co-workers. These and other job accommodations were cited in the Department of Labor (1) study on accommodations by federal contractors. The overall conclusion based on the analyses in this report was that accommodations of persons with disabilities were "no big deal" for the contractors responding to the survey. Also, the study revealed that accommodation efforts were generally effective on the job. Contractors frequently reported that the accommodation would benefit the employee if promoted to a new job and often stated that nondisabled workers also benefitted.

Job accommodation may be conceptualized as a five step process. The steps provide a general framework within which specialists can apply their expertise to particular problems posed by the functional limitations resulting from different disabilities.

1. Ensure that the worker is qualified. Step 1 ensures that the individual has the critical skills necessary to perform the job. For example, it would be ineffective to modify a drill press in a machine shop for a person who could not read blueprints. If the basic skills are present and there is a suitable candidate for the job, then the job modification process can continue.

2. Secure job and task information. Step 2 is to perform a job and task analysis. This analysis first lists each step of the job and then lists the necessary requirements for performing each step. For example, one step in operating a drill press is to reach for the press handle. The reach involved is 72 inches from the floor.

3. Determine job redesign needs. Step 3 in the job accommodation process is to look for matches and mismatches between the requirements of the job and the capabilities of the potential employee. For example, the employee may not be able to reach 72 inches from the floor. Those areas with mismatches are flagged for redesign later. Often, only a few parts of the job will require redesign or job modification.

4. Explore job modification alternatives. Step 4 in the process is job modification--the actual redesign of the equipment, the job or the facilities. Job modifications include not only "hardware", such as the physical worksite and its environment, but also, "software" changes such as work procedures, methods, and policies. Modifications need not be expensive, complex or technical to be successful. Often, the simpler modifications are more effective.

Even though many design ideas and "off-the-shelf" modifications reflect common sense solutions, the skill and experience of the designer remain important. It is wise to consult others for "design tricks" and assistance. Locally, there are rehabilitation facilities, sheltered workshops, universities, and of course, the individual with a disability. Often people with disabilities have made many accommodations for themselves at home and these same accommodations may be the answer to the design problem on the job.

5. Implement the most effective modification(s). Step 5 is simply the selection of the most effective modification(s) from among the alternatives. Each specific application will have different criteria for this choice, but cost, job flexibility, and space limitations are often important.

The main focus of this presentation will be on Step 4--modifications to the job, equipment, and/or facilities that will help an individual perform the job. The presentation will address this in terms of major limiting conditions which cut across a variety of disability types: (a) lifting and carrying, (b) manual tasks, (c) mobility, and (d) seating. Each of these will be reviewed in terms of issues relating to disability and problems and solutions with case studies to illustrate the accommodation problem and solution. A final section on professional and literature resources is provided for the convenience of the reader accessing assistance.

Lifting and Carrying

General Information

Though some jobs are more strenuous than others, no job is completely free from lifting and/or carrying tasks. Even so-called sedentary jobs can present difficulties to persons with limitations in their ability to lift or carry. Balance problems, strength or stamina limitations such as those resulting from stroke and heart conditions, motor impairments such as those caused by spinal cord injury or cerebral palsy, and amputations can cause difficulty with lifting and carrying. In some individuals, lifting may cause fainting, dizziness or seizures. The most important factor, however, is not the impairment but the resulting limitation which significantly affects work productivity or safety.

One of the most common reasons for difficulty in lifting or carrying is injury to the lower back. Eighty percent of the American population will suffer from low back pain at some time in their lives. It has been estimated that low back pain costs between $20 and $30 million in worker's compensation costs and lost productivity (2). In addition to pressures encouraging workers to perform to the fullest, many life style factors contribute to the weak back many Americans have. Preventive measures such as job redesign and physical fitness, though not job accommodations in the strictest sense, are the most effective

measures against limitations in lifting and carrying due to back injury. Of all the impairments mentioned above, back injury is the one which the employer can actually prevent. The following job design and modification guidelines apply to preventing back injury as well as minimizing resulting limitations from this and other impairments.

Problems and Solutions

1. Objects to be lifted and/or carried are too heavy or bulky for the worker to handle.

   * Assign the task to more than one worker.
   * Distribute the load into more than one container.
   * Use assistive equipment such as overhead cranes, lifts, and carts.
   * Modify the tasks from lifting to lowering, lowering to carrying, carrying to pulling, pulling to pushing.
   * Assure firm grip on object with handles, hooks, or other features.
   * Minimize container weight.
   * Provide supports for movement of objects, such as positioning guides and tracks, so that the worker need not fully support object during lift/carry.
   * Avoid chance of load shifting inside container causing loss of balance.
   * Change container shape so object load can be borne close to body.
   * Use large wheels/casters on carts to minimize effort.
   * Minimize friction on surfaces where objects are slid, rather than lifted.

2. Objects are located in places difficult for worker to access.

   * Locate objects within 20" - 52" above floor whenever possible.
   * Locate objects as close as possible to same level where they must be lifted/carried.
   * If worker must transfer load from in front to behind, carrying distance should be either one full step or no step away.
   * When object assembly is involved, assure access to all sides of assembly (use turntables if necessary).
   * Avoid lifting objects with one hand only.
   * Provide height-adjustable work surfaces, storage, and seating.
   * Minimize reaching into deep storage containers through use of spring-loaded or sloped (gravity feed) bottoms.
   * Use only sturdy storage systems.

3. Frequency or duration of lifting/carrying task causes excessive fatigue.

   * Allow more time for completion of task.
   * Reduce frequency of task.

* Rotate workers to limit exposure to stress.
* Allow periodic rest.
* Screen workers to fit job.
* Control environmental extremes; acclimatize workers.

(The above guidelines were compiled from Ayoub, M. A., The Journal of Occupational Medicine, 24(9), September, 1982, 668-676.)

Case Studies

1. In a large television repair shop, a worker with limited strength in his legs faced the regular task of lifting television sets from the floor to his work table. Following repairs, he had to lower the sets to a pallet on the floor for removal. He was having increasing difficulty with this task, risking damage to merchandise and injury to himself and others.

Since each repair technician at this shop works independently, asking for assistance from a co-worker would have disrupted overall productivity. As an alternative, the company purchased a free-standing electronic platform lift which would raise and lower the sets for him. This device cost approximately $450.

2. In a major chemical plant, a set-up mechanic was experiencing occasional back pain and lost work time as a result of lifting heavy boxes of mechanical equipment spare parts. The weight of the boxes when loaded was so excessive that all set-up mechanics experienced difficulties. Consequently, the job was redesigned, and each box's capacity was limited in order to prevent overloading and subsequent injuries.

Manual Tasks

General Information

Difficulty in the performance of manual tasks may be described as limitations of the functions of handling and fingering, reaching, and sensation. The functional limitations may be due to neuromuscular conditions such as multiple sclerosis and cerebral palsy, paralysis due to spinal cord injury, arthritis, stroke, carpal tunnel syndrome, traumatic injury to hands and arms, the effects of medication, and a variety of other conditions. The field of human factors and industrial engineering has generated significant information about manual work and related conditions. Poorly designed work patterns, vibration and repetitive hand stress can contribute to acute and chronic hand, arm, shoulder and back injuries. Good job design can prevent disability in performance of manual tasks.

Careful examination of the job tasks, equipment, job site and employee skills will provide the employer and employee with information to decide what accommodations or modifications will be most productive. In general, the principles of work simplifi-

cation can be used to increase efficiency and productivity for the worker with a disability. Time and motion studies can be conducted to analyze jobs. Systematic analysis of occupational factors for chronic hand, arm and shoulder conditions can also be done to improve job design.

The following equipment, job design, and modification guidelines illustrate means by which persons with manual limitations can continue their vocational pursuits.

Problems and Solutions

1. Task simplification techniques for workers who are disabled.

   * Collect tools and equipment in one place prior to beginning work on the task.
   * Eliminate unessential movements or features and combine essential motions.
   * Sequence can be changed to increase efficiency.
   * Mechanical and assistive devices may prove useful.
   * Assure that the environment is properly safe and provides the necessary support.

2. Minimize hand and forearm strength for task accomplishment.

   * Suspend or counterbalance heavy tools.
   * Use tools which can be used by either hand.
   * For single-hand tools, grip span should be 2" for optimal use and should not exceed 4".
   * Care should be observed in the design of the handles of tongs/pliers to avoid pinching hands and fingers.
   * Jigs can be situated so that assembly operations can be done without wrist flexing.
   * Handle surfaces need to be shaped to contact the maximum surface of the inner hand, thus distributing forces evenly to avoid treating pressure points.
   * Design hand tools for operation with a straight wrist. The rule is "bend the tool, not the wrist".
   * Align handles centrally to avoid rotational movements of torque on the hand.

   (The principles in 1 and 2 above were adapted from Armstrong, T. (1983). Ergonomics guides: An ergonomic guide to Carpal Tunnel Syndrome. American Industrial Hygiene Association.)

3. For severely disabled workers such as those with quadriplegia, advances in technology provide endless opportunities. The tasks of manipulation can be simulated by electronic equipment.

   * Voice control, sip and puff, and Morse Code interface systems can be utilized to operate industrial and/or computerized equipment by an individual with severe functional limitations.
   * Braces, splints, and other such devices may facilitate job

performance of manual tasks.
* Knobs, levers, and plates can be constructed to respond to any sort of touch.

4. Additional worksite modifications for manual task activities.

* Rearrangement of duties.
* Electric tools over manual tools.
* Flexible work hours.
* Division of labor among workers.
* The use of personal assistants on the job.
* Many other ergonomic considerations.

Case Studies

1. An accounting clerk with quadriplegia works from an electric wheelchair. Deadlines were often missed due to inefficient workplace design. On evaluation of the worksite, it was observed that the calculator was located on the desk of a co-worker, a telephone was located across the room, and the computer terminal was at yet another work station. Organization of this equipment was provided on a turntable at the accounting clerk's work station resulting in an increase in productivity and accurate meeting of deadlines, as well as safety for other workers who avoided climbing across cords scattered from desk to desk. The cost to provide this equipment in one location was $400.

2. A manufacturing assembler complained of repeated pain in both wrists and hands throughout the workday. Productivity was severely compromised and work time lost. Job analysis indicated constant wrist bending demands in reaching for parts in boxes. The work station was redesigned to provide storage of parts on each side of worker and at table height with shallow bins. The employee was encouraged to take breaks at regular intervals to rest instead of working straight through all morning and afternoon shifts. The job accommodation cost $100 for new storage bins. Employee sick leave decreased and productivity returned to normal.

Mobility

General Information

Mobility impairments limit the capacity of individuals to move themselves freely. This includes people who have difficulty walking long distances, climbing stairs or who use wheelchairs, as well as those who are legally blind. The following conditions may cause a person to be mobility impaired: cancer, arthritis, amputations, cerebral palsy, multiple sclerosis, spinal cord injury, stroke or head injury.

Mobility in the workplace is not limited to one location, but must take into consideration all activities related to work, beginning with transportation access in the parking lot, building entrance and exit, work station design, and including meals, com-

munication, personal hygiene and employee safety. In new building design, accessibility can be considered in the planning stages, therefore eliminating unnecessary cost. No one is more familiar with mobility needs than the employee him/herself. Employers are encouraged to involve their employees in the planning and implementation stages when making mobility accommodations. There are many accommodations, most of them relatively inexpensive, that an employer can provide for mobility impaired employees, or in anticipation of hiring such individuals.

The following mobility guidelines serve as a general reference for employers.

Problems and Solutions

1. Parking lot is inaccessible for wheelchair use.

   * Parking spaces near the entrances of buildings should be reserved for employees and visitors with disabilities.
   * Signage should be prominent, denoting use of space by the person with a disability. Signs are available from a number of distributors.
   * Parking spaces should be no less than 12 feet wide. This will allow sufficient space for the use of wheelchair van lifts, and provide adequate space for a person using crutches or a wheelchair to get in or out of an automobile.

2. Building entrance is inaccessible.

   * Build a ramp. Specifications for making buildings accessible are available from the American National Standards Institute, as well as in the barrier-free codes of individual states. If a permanent ramp is to be built, it should have a slope of 1 foot rise to 12 feet in length. Handrails are necessary. Length, turning space width, bottom clearance and surface should all be taken into consideration.
   * Consider use of a portable ramp which is commercially available. They are usually constructed of steel or aluminum and can be used for curbs or a minimal number of stairs.
   * Install a wheelchair lift. A wheelchair lift may be the least expensive alternative and most functional for areas with a high rise. Wheelchair lifts come in different configurations and their use will depend on the specific problem. Porch-type lifts are those that travel vertically, usually to a maximum of 8 feet.
   * Entrance doors should not be less than 32 inches wide; 36 inches in some states.
   * Use accessible door hardware. It may be necessary to change the door knob to a lever in order to make it easier for people using crutches or those with limited hand function to open the door. Automatic or powered door openers are the easiest way for anyone to get through a door.

3. Work station accommodations are necessary.

* Whenever possible, desks or work tables should be adjustable to accommodate the broadest types of disabilities.
* Storage and shelving should be within easy reach of a seated person.
* Provide storage for walking aides, i.e., crutches, walkers, or canes.
* Establish safety plans for all emergencies.
* Environmental control systems allow people to remotely control appliances in their environment.
* Use caddies to carry things.

4. Floors are slippery for crutch walkers.

* Special wheelchairs and adaptive equipment can facilitate mobility.
* Three wheeled scooters can accommodate people who have difficulty walking long distances.

Case Studies

1. John is a 51 year old man with multiple sclerosis. He worked for 15 years as a machinist and toolmaker at an industrial research laboratory before becoming disabled. As a result of the disability he is unable to ambulate or stand for any period of time. He has lost some of his fine manual dexterity. Due to his limitations he was unable to return to his previous employment. Because of his extensive experience in a machine shop and his knowledge of tools, a job was found for him in a manufacturing plant. His job involved supervising the operation of the plant's tool room. The biggest obstacle to employment was his inability to move around the plant. To overcome this problem, he was provided with a motorized three wheeled cart. This allows him to be independent in mobility, and thus, get around the plant in a timely manner, actually a bit faster than his co-workers can walk.

2. Tony worked as a "lineman" for a cable TV construction company. He suffered a T11-T12 fracture of his spine from a fall from a telephone pole, leaving him with paraplegia. He now uses a manual wheelchair to get around. He very much wanted to go back to work for the cable TV company doing what he did before his accident. Tony is independent in walking while using long leg braces and crutches. The company was willing to take Tony back to work and agreed to modify a bucket or cherrypicker truck for his use. These modifications included installing hand controls in the van, grab bars in strategic locations and a heater in the bucket. Grab bars were installed around the outside of the van as well as on the inside roof. The grab bars allow Tony to walk around the van easily. Using grab bars on the bucket, he can pull himself into the bucket. Once in the bucket, Tony has enough support from his braces and the bucket to perform all the tasks of his job. The only other major modification

required was a heater for the bucket. This will prevent him from getting frostbite during the winter months, as paraplegics generally have trouble regulating body temperature and have no sensation in the legs.

Seating

General Information

The importance of workplace design becomes evident in evaluating seating for persons with and without disabilities. Difficulties in sitting can occur due to a variety of physical conditions including back problems, conditions of hips or lower extremities, arthritis, paralysis or body weakness. Seating accommodation in the workplace should consider all individual needs as well as work assignments. Well designed seating can even assist in the prevention of disability. The primary purposes of seating should be to promote and maintain physical functions, provide safety and conserve human energy needs. To plan for seating accommodations, the user's work activities, work habits and physical environment should be closely examined.

Seating can determine posture and movement patterns. The mechanics of sitting include awareness of balance, hip and leg pressure, as well as alignment of the vertebral column. There is no consensus on the best sitting posture for an individual, or the best chair for everyone. The preferred recommendation among medical professionals, engineers, and designers is to provide individual workers with a fully adjustable chair.

Generally, individuals who have a medical condition are most familiar with their physical needs, and should be asked directly if they need special seating, or be given an opportunity to evaluate seating options. The following job design guidelines apply to prevention of physical problems as well as maximizing of human performance in the workplace.

Problems and Solutions

1. Employees complain of excessive fatigue at the end of the work day.

    * Seating should assist physical activity. Good seating does more than just make good sense; there are financial incentives. Studies of seating indicate that a well constructed chair may add as much as 40 minutes of production to a work day. Establishing the correct distance from the work surface is best accomplished through the use of adjustable seating. Additionally, seating should allow the user's feet to touch either the floor or a foot rest on the chair. The seat should be adjustable between 14-20 inches above floor or footrest. Many commercially available chairs include manual and pneumatic height adjustment features.

2. An employee with a back problem returns from medical leave only to find that he/she cannot sit comfortably at the desk.

* Good body support is necessary; 60% of body weight is supported in seated positions.
* The backrest should be easily adjustable for both angle and height to provide appropriate lumbar support. The angle of the backrest influences intervertebral disc pressure. Width of backrest should accommodate the individual.

3. The personnel office informs you that the state vocational agency wants to place several individuals with disabilities in your shop. You are unsure if the work stations are suitable for people in wheelchairs.

* Frequently, industrial engineering staff can consult with rehabilitation professionals to determine proper seating needs in the workplace. Alternatives to conventional seating include: (a) semi-seating, which allows a user to lean while standing, (b) pneumatic height or seat mechanisms, which, by the flick of a lever, change height and seat angles while occupied, and (c) electric motor scooters which are quick and safe to operate and are commonly seen in the workplace.

Case Studies

1. A copy machine operator with arthritis has limited movement in her spine, causing difficulty in reaching up and across the machine to perform certain tasks. Because this machine was too complex to alter, the operator's working height was changed by provision of a height adjustable stool. The stool provided full back support and a platform on which to rest her feet. The cost of the stool was approximately $350.

2. A secretary with a herniated disc was losing worktime due to severe pain in her lower back. Since she performed work at a desk and separate computer work station, the table heights varied. With the addition of a pneumatic height adjustable chair with good back support, her pain was relieved with resultant consistency in attendance and increase in productivity. The total cost of accommodation was $550.

Hearing

General Information

Hearing impairment affects more Americans than any other chronic physical disability. Sixteen million Americans experience hearing losses ranging in degree from mild to profound with many ranges in between. Fourteen million of these persons are hard of hearing, which means that they often can hear satisfactorily with the help of amplification devices such as hearing aids. The other two million are considered deaf, which means that they cannot hear or understand conversational speech or most environmental sounds, even when amplified.

Major modifications in the work area to accommodate hearing-impaired employees are rarely necessary. The accommodations

generally needed relate to enhancing communication with co-workers and the public. Careful job analysis can help an employer sort tasks into those that require verbal skills and those that do not.

There are three primary modes of communication used by hearing-impaired people; manual, oral and simultaneous communication.

Manual communication involves communicating words, ideas, and feelings using the body (hands, arms, face). It includes fingerspelling (handshapes to represent letters of the alphabet) and sign language (unique sets of movements/handshapes and hand positions representing words).

Oral communication means communicating words, ideas, and feelings through speech and speechreading. Many hearing-impaired persons use their voices for communication.

Simultaneous communication combines oral and manual communication modes. This means that the person talks and signs at the same time.

Problems and Solutions

1. Communicating with a hearing-impaired person is a matter of sensitivity and common sense. Some simple tips follow:

   * Move away from background noise so that the hearing-impaired person's hearing aid can be helpful.
   * Stand or sit in a well-lighted area. Natural gestures and facial expressions are important in communicating with the hearing-impaired person.
   * Get the hearing-impaired person's attention by using a visible signal, such as a tap on the shoulder or a wave of the hand.
   * Ask the hearing-impaired person what you can do to make it easier for the two of you to communicate.
   * Speak slowly and clearly and in a normal tone of voice. Do not exaggerate mouth movements.
   * Look directly at the hearing-impaired person, even if an interpreter is being used. If you turn your face, the hearing-impaired person may have difficulty seeing your lips and/or facial expressions.
   * Avoid smoking, eating, drinking, or putting your hands in front of your mouth while you are speaking.
   * Stay in one place while speaking. Watching the lips of a pacing speaker is difficult.
   * Use short sentences and repeat them if they are not understood the first time.
   * Keep in mind that only three out of ten spoken words are visible. Even a skilled speechreader has to make some guesses about what is said.
   * If you must use difficult or complex words, write them down. Then explain them. It is unlikely that someone can

speechread an unfamiliar word.

* Check to make sure that the hearing-impaired really understands you and that you understand him. Problems often result from pretending to understand.
* If something is not understood after it has been repeated once, re-phrase the message using simpler words or the same words in a different order.
* Take time to communicate. Try not to appear rushed, impatient or disinterested.
* And remember ... Do not hesitate to use paper and pencil to make sure there is communication. Written notes are far better than misunderstanding.

2. Job site accommodations

* Hearing aids are helpful for some hearing-impaired people. They magnify whatever residual hearing the person has and may support his/her speechreading skills. They do not clarify unclear sounds.
* Some hearing-impaired persons can use the telephone if it has an amplification mechanism or if they have a hearing aid with a T-switch. Others can use a TDD to send and receive messages. TDDs send typed messages across telephone lines and display them on a screen or tape.
* Offer to use interpreters during job interviews when necessary. Interpreters rarely are required once the job site is adapted and the employee is familiar with the work environment and responsibilities. Interpreters also should be considered during training sessions that include hearing-impaired employees.
* Co-workers may wish to learn sign language if the hearing-impaired employee uses that mode of communication. Some hearing-impaired employees enjoy teaching small groups of their fellow employees.
* Consider the deaf person's sensitivity to noise. A noisy environment may create a barrier to communication for someone who wears a hearing aid.
* Use visual cues to enhance communication. Use of a round or oval table during meetings will facilitate the line of sight between people, as will semi-circular seating arrangements. Open doors or panels in offices allow deaf persons to see into rooms before entering.
* Use paging devices to contact deaf employees in the field. Radio frequencies have been set aside by the FCC to permit the use of "tactile pagers". These are vibrating paging devices that can be used to contact or warn deaf employees in the field or in remote locations. Such pagers usually can be incorporated into existing security paging systems.
* Consider the buddy system for new deaf employees. This can simplify the job transition for deaf people. Co-workers should be responsible for alerting deaf employees during emergency situations such as fires or evacuations.
* Use signaling devices for deaf employees. Adapt auditory signals such as sirens, doorbells and ringing telephones to

visual signals, for example, a flashing light.
* Minimize vibrations in the work area. They distort sounds received by a hearing aid, making it difficult for the deaf person to concentrate.
* Notify security if a deaf employee will be working alone at night or during off hours, such as weekends.

Case Studies

1. William "W.O." Schwall is a hearing-impaired person in a nontraditional job--he is a telephone installer for Southwestern Bell. A telephone installer's job requirements are rigid, but Schwall qualified and received the same training as hearing trainees: lectures, demonstrations, and self-instruction. The only modifications in Schwall's training were an interpreter and a written script of some audio cassettes.

In addition to translating spoken words into sign language, his interpreter provided tutoring and short explanations when required. Schwall's supervisory personnel and training team worked together to identify potential problem areas, including communication with customers and other departments, telephone testing, and diagnostic problems with existing phones. Schwall's supervisor had cards printed to identify Schwall and his job stating, "PLEASE SHOW ME WHAT YOU WANT ME TO DO." He was also given a message pad. He soon found that the pad was all he needed to communicate with customers. Southwestern Bell purchased TDDs for Schwall, including a Porta Printer for the main office and a pocket-size TDD. These units enabled him to reach the home office, which could relay messages to other areas. Schwall's many years of job success are due to several factors: supportive management, supervisors who meet with him regularly to discuss progress, co-workers who attend sign language classes, customers who respond positively, and Schwall's own hard work.

2. A registered nurse at a hospital clinic experienced progressive hearing loss from a childhood injury. Employee and employer feared that the communication of patient information was at risk.

With the assistance of rehabilitation personnel, the nurse's job was restructured. The head nurse and other staff members determined that this valued employee could utilize her skills to maintain medical equipment and schedule co-workers. Managing inventory and medications, and reviewing medical record systems were other responsibilities assigned. These accommodations involved no financial costs to the employer.

Seeing

General Information

It is estimated that over six million people in the United States are visually impaired, i.e., have difficulty seeing due to partial, total or progressive visual loss. Visual loss may

include a small problem such as difficulty distinguishing light, colors and figures or a more severe problem which is commonly referred to as blindness. In the technical sense, blindness refers to total loss of light perception. People are considered to be legally blind if, even with the use of glasses, they can see something no better at 20 feet than someone with normal sight can see at 200 feet (Templer & Zimring).

Visual impairment is caused by chronic disease such as diabetes, heredity or prenatal influence. Many conditions are associated with the aging process such as cataracts and glaucoma, or traumatic injury such as an automobile accident. Malnutrition and infections can cause blindness, such as commonly seen in developing countries.

People who are totally blind must learn alternative management techniques for movement, dressing, communication and other daily tasks since they cannot rely on visual environmental information. The style of management of personal and vocational tasks for the visually impaired are quite individualized. What one person needs for communication, another may not. A cane is used by many visually impaired persons for mobility. Newly developed canes may utilize electronic sensors which detect obstacles. A small group of visually impaired people use leader dog guides.

Getting around the workplace can be accomplished with the help of environmental cues. In the case of a partially sighted person the use of lights, strongly colored or red markers can help locate on-off switches, machine controls, and mechanical tools. Stair treads, light switches, and doorknobs/locks can be similarly noted. Consistent location of furniture and other items can map path for an individual with blindness. The sound of other workers, equipment smell, and touch can provide the necessary tools for travel.

Tools are available with braille markings to accomplish almost any task. Rulers with braille markings allow a blind carpenter to make measurements as do calipers and levels. Other common tools from barometers and scales to tire pressure gauges are available in braille as well.

Some aids and devices take advantage of advances in technology, especially in microelectronics and computer technology. Computer terminals with voice output, data processor and light sensing probes are available from a range of manufacturers. Voice output devices such as readers and talking calculators provide limitless resources. The Kurzewil reading machine, which looks like a desktop photocopier, scans printed documents and records copy images in its memory. The machine then applies the correct stresses and pauses of spoken English. Another talking computer terminal developed by James Kutsch uses a voice synthesizer to read words, punctuation and spaces.

Blind and visually impaired people lead active, independent lives and work in many industrial, technical and office settings.

Many excellent educational institutions for blind and visually impaired people have provided opportunity for entry into professional fields. It is estimated that over 80% of 32,000 jobs listed in the Dictionary of Occupational Titles can be performed by the visually impaired if proper job analysis is performed by a trained professional, and the individual is given proper training and equipment.

Problems and Solutions

The number and variety of jobs performed by persons who are blind or visually handicapped suggest that it would be extremely difficult to rule out any type of employment without a case review of the job tasks. The nature of disability varies from person to person. Some are able to read ordinary print, some can read regular print only for brief periods of time or under special lighting, and some can read large print. For some people, the usable vision fluctuates within a day or over a period of time. Individuals with the same type and degree of visual impairment, including totally blind persons, differ in how much and in what activities their visual loss is actually a handicap. This variation reflects the techniques they have learned or figured out for themselves to accomplish by alternate means, as well as their particular pattern of abilities and personal characteristics, including general intelligence, physical stamina, and memory.

Some special problems which are noteworthy include:

1. Mobility. Employers are rightly concerned about an individual's ability to get to the job.

   * Persons with a visual handicap are trained in a variety of techniques to be able to get to work without difficulty and on time. These techniques include cane travel or use of a dog guide.

   It is also expected that the individual be able to travel freely in the work environment.

   * This can be accomplished with orientation, either provided by the employer or with the assistance of a mobility instructor. This should not present any significant problem to the employer or the employee.

2. The Ability to Read Print. It is important to determine whether the job tasks actually require the ability to read the printed word.

   * A job analysis can be performed which would make that decision. If this ability is necessary, several ways can be suggested to overcome this problem. These include modifying or restructuring the job, or the use of alternate techniques to perform the job duties. Where necessary, technology can be utilized. There are a variety of devices

which can translate printed material into tactile form. Recent technology can also provide a voice output for the employee. This technology is applicable not only to reading printed word, but also to reading measuring instruments, such as calipers and other mechanical equipment.

Further information on the types of jobs performed by persons who are blind or visually handicapped can be obtained by contacting the National Consultant on Employment at the American Foundation for the Blind, 15 West 16 Street, New York, New York 10011 (212/620-2037). The American Foundation for the Blind also has a National Technology Center which can provide information on adaptive equipment.

Case Studies

1. Ms. Jones is a totally blind message secretary in a large insurance company. Her work performance has been successful; however, after five years' employment she is looking for a promotional opportunity.

The position of accident report clerk became available. This position required answering incoming telephone calls and reporting the details on accident reports. It was necessary for this employee to become familiar with a lengthy, printed Company Policy and Procedures Manual. She had to read and complete forms which had predetermined spaces for information and which other employees could fill in by handwriting or typewriting.

The employee was able to construct her own braille circular card file to quickly access the most frequently used material from the Manual. With the assistance of the State Agency, a desk top microcomputer with voice output was provided to allow programming of the forms. The employee could access the forms through an earphone connected to computer voice output while using her other ear to listen to the caller. A rehabilitation engineer developed an adjustable margin center for the printer which allowed the employee to set up each form properly.

2. A totally blind 25-year-old electronics technician graduated from a community college with an Associate Degree in electronics. He could read braille and also was able to read print with an Optacon. The position required the repairing and maintenance of small electronic devices. The job also required the ability to do point-to-point testing of printed circuit boards, reading or schematics, replacement of bad components, some soldering, and reading of digital multimeters, as well as an oscilloscope.

The digital meters were adapted with a special output device so that the employee could hear the readings. The auditory-tactile adaptive device for the oscilloscope was recommended to enable him to identify wave forms and measure amplitude and frequency. In order to do point-to-point testing of various boards, several templates were used. It was noted that many of these adaptive devices were utilized by the individual during his training at the community college.

Professional Resources

There are many professionals who can assist with job accommodations. Although there is not time to do justice to all potential sources of assistance, a few professional groups are identified. A more extensive review is provided in the presentation on Job Accommodation Resources which follows. Professionals who might assist with a variety of accommodation engineering problems include industrial, bio-mechanical and/or human factors engineers, most easily located through their professional organizations such as The Human Factors Society, American Industrial Hygiene Association, Rehabilitation and Engineering Society of North America and the American Institute of Industrial Engineers.

Medical rehabilitation personnel may also be able to assist. They can be located through local rehabilitation facilities, hospitals, and insurance organizations, or through local medical societies. Organizations such as the Visiting Nurses Association may be useful. Additional resources include occupational and physical therapists located through hospitals and rehabilitation facilities or through professional associations such as the American Occupational Therapy Association and the American Physical Therapy Association.

Interior designers are becoming more involved in job accommodations through the design of office furniture and work stations in collaboration with engineers and other professionals. The individuals can be reached through organizations such as the Institute of Business Designers and the American Society of Interior Design.

Organizations which cut across professional disciplines such as the National Rehabilitation Association may be useful in identifying local sources of assistance. A variety of human services agencies such as the State Vocational Rehabilitation Agency are frequently helpful in providing expertise related to disability. Also, the President's Committee on Employment of the Handicapped and the state and local committees are available to assist in this area.

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Job Accommodation Resources

Section 5

JOB ACCOMMODATION RESOURCES

The availability of resouces to facilitate job accommodations is an important factor to be considered. Practicing engineers should be aware of resources which can assist in understanding disability as well as technical issues. There are a number of service programs and professionals working in the general field of rehabilitation, many at the local community and regional levels. These resources can be extremely valuable in making the linkages to people with disabilities who require some form of accommodation. Prior to discussing these resources, it is important to review the role of the engineer in job accommodations.

Role of the Engineer in Accommodations

Accommodating a newly employed person with a disability or a veteran employee who has recently become disabled should be a team effort. In order to provide a framework for teamwork, an examination of the components of a successful employment effort is necessary. Also, it is important to recognize when to involve the appropriate members of the team. Figure 1 illustrates the steps and the team members needed for each step in the accommodation process.

In a large company, the engineer will likely be a part of a team headed by the personnel or medical specialist (Figure 2). In a small firm, the engineer may be the only professional to coordinate efforts to gain successful employment (Figure 2). In a large firm, many of the resources are available internally, while with small firms, most will be available from outside the organization.

The resources needed depend on the role of the engineer. For teams where the engineer is asked to supply expertise on job design and possible redesign, technical engineering resources are needed. Others on the team will serve as resources to help with other aspects of the employment process. If the engineer assumes the role of team leader, coordinating all efforts to achieve successful employment, it will be necessary to know what community resources are available to help with these other aspects.

The following review provides information on a variety of useful resources for job accommodations, grouped for discussion on the basis of community based programs available in many areas and resources for technical redesign and engineering.

Community Based Resources

Although not an exhaustive listing, the following resources are based at the community level and include a variety of non-engineering specialties and organizations.

Figure 1

The Accommodation Process

Step 1: Know the capabilities and limitations of the individual and the specific demands of the job.

Team: Personnel, medical professionals, and rehabilitation specialists to identify the individual's capabilities.

Supervisor, co-workers, and engineer to quantify demands of the job.

Step 2: Determine which aspects of the job are problems (barriers) for the individual in terms of specific tasks and the work environment.

Team: The person with a disability, engineer and medical professionals.

Step 3: Determine possible solutions to overcome the barriers: change the job--change the equipment--change the capabilities of the person.

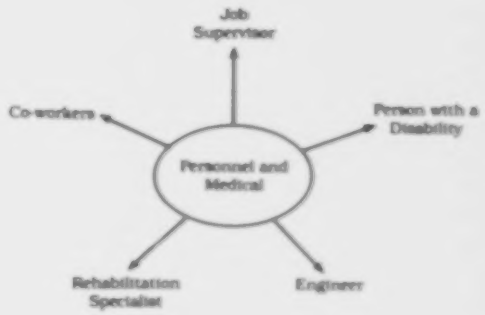
Team: For the job--supervisors, co-workers, personnel officer and industrial engineer. For the equipment--rehabilitation specialist, engineer and designer. For the person's capabilities--training specialist and rehabilitation specialist.

Step 4: Initiate the changes and evaluate.

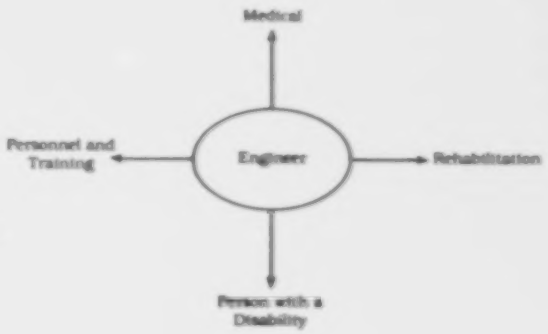
Team: Everyone.

Figure 2

Large Company Model



Small Company Model



Ergonomists and Human Factors Specialists

Colleagues who have engaged in this endeavor should be extremely valuable resources. Since that is likely a specialty area of the audience, there is no need to describe such specialists. However, there are others who have begun to develop expertise in this area in combination with other areas of practice and it should be possible to capitalize on their experience.

Vocational Rehabilitation Agencies

Every state has a vocational rehabilitation service funded by state and federal funds. These agencies have regional offices throughout the state and provide direct counseling, treatment and job placement services to persons with disabilities. They have funds to purchase services and may be able to assist with some job accommodations.

Rehabilitation Facilities

There are specialized facilities in many communities providing direct services to persons who are disabled. These organizations include familiar programs such as Goodwill Industries and the Easter Seal Society. Also, there are comprehensive facilities in metropolitan areas which offer medical, vocational and related services. There are many small rehabilitation workshops located in communities throughout the country providing work adjustment and employment services.

Consumer Organizations

These groups are usually composed of individuals with disabilities and their families and are often focused on specific disabilities such as deafness and blindness. They usually work to provide improved services and advocacy for different programs and services. There is a trend toward coalitions of such groups in which several groups come together to realize a common goal. Examples of consumer groups are the Blinded Veterans Association and the American Council for the Blind.

Private Rehabilitation Practitioners

There are a number of individuals and corporations practicing rehabilitation counseling and related services through private for-profit arrangements. These practitioners are frequently involved in rehabilitation services to recipients of insurance benefit programs, and operate on a fee-for-service basis.

Medical and Allied Health Practitioners

Many physicians are involved in rehabilitation at various levels of service. Specialists in orthopedics, ophthalmology, and other disciplines are extensively involved in rehabilitation programs and often work in collaboration with rehabilitation spe-

cialists. Additionally, specialists in allied health fields such as occupational therapy are involved in rehabilitation.

Suppliers of Rehabilitation Equipment

Suppliers of equipment such as prosthetic appliances (e.g., artificial limbs) also have extensive contact with persons with disabilities. The fitting and training in use of such appliances are major roles of these specialists. Also, there are manufacturers of everything from lifts for vans to talking calculators.

Rehabilitation Engineers

Engineers from various disciplines have begun to specialize in rehabilitation engineering. A number of practitioners are working in private practice and in rehabilitation organizations and facilities. These engineers frequently come from industrial engineering backgrounds and apply their skills to the needs of individuals with disabilities in work and activities of daily living. There are a number of federally funded rehabilitation engineering centers around the country, specializing in research and training in this area.

Affirmative Action Specialists

Large organizations have specialists in personnel work who are charged with the responsibility of recruitment and placement of workers with disabilities in addition to minorities and other target groups. These individuals often assist in the accommodations involved in placing workers with disabilities and may be valuable as a resource in this area.

Employers Experienced in Accommodations

There are a number of employers around the country who have experience in employing and accommodating handicapped workers. Many large organizations in all areas of the country have gone through the process and can share valuable information.

This is a quick overview of the community based resources available for assistance and guidance in working with persons with disabilities. Many of these resources do not have technical engineering capability. However, they have the experience with disability and, when coupled with engineering expertise, can assist in understanding disability, its consequences, and the accommodation needs of persons with disabilities.

Resources for Technical Redesign and Engineering

Research and Innovation Resources

A second area which is somewhat more remote includes the organizations and institutions engaged in research and innovation in rehabilitation. There are three major entities which may be helpful.

National Institute of Handicapped Research (NIHR). This organization is the primary funding source for research and innovation in rehabilitation. Although the Institute does not directly conduct research, it funds the primary organizations which do--rehabilitation engineering centers and the research and training centers.

Rehabilitation Engineering Centers. NIHR funds a variety of centers conducting engineering research dealing with specific disability related problems. These centers are charged to conduct research and disseminate the findings to practitioners and other scientists. The centers and their specialty areas are presented in a listing at the end of this chapter.

Research and Training Centers. Although not as directly involved in engineering, a number of centers are funded by NIHR to conduct disability specific research in areas such as blindness and deafness, and research related to problems such as job placement and vocational rehabilitation. These centers have information which may be of considerable value in job accommodations. For example, the West Virginia Research and Training Center is the host organization for the Job Accommodation Network (JAN) which is reviewed later. Also, the Arkansas Research and Training Center in Vocational Rehabilitation conducts research in areas such as employer development and work adjustment.

Information Systems

There are several information systems which can be very useful to the practicing engineer in accessing information about job accommodations. With the advent of computerized information systems, such access opportunities have become readily available to the rehabilitation community. The following information describes the three primary systems and also some brief information about additional systems which may prove to be useful resources.

Job Accommodation Network (JAN). Perhaps the single most useful resource on job accommodations is this information network established as a joint venture of the National Institute of Handicapped Research, the Rehabilitation Services Administration, the President's Committee on Employment of the Handicapped, and the West Virginia University Rehabilitation Research and Training Center.

JAN is a nationwide computerized network of information on accommodations employers have made to enable workers with disabilities to be employed or return to work. The network was established to accumulate a database on accommodations made by employers, to facilitate employment of workers with disabilities by targeting functional or job-related limitations.

According to a news feature in the Wall Street Journal, November 1984, JAN has served over 300 companies including Westinghouse Electric Corporation, Sears Roebuck & Company, and

du Pont. At that time there were over 4,000 ideas for accommodations in the database.

JAN utilizes a computer database with human factors/ rehabilitation engineer consultants who answer inquiries from employers. The consultants translate the employer's job accommodations needs into targeted job accommodation strategies. Also, the consultants have access to a network of experts who assist with unusual or difficult problems. A toll free number is provided for inquiries, thus reducing the cost to the employer. Figures 3 and 4 are examples of types of accommodations provided by the system.

AbleData. This system contains a listing of more than 10,000 commercially available aids and devices for people with disabilities. Information is provided on the products as well as any evaluations or consumer feedback. Devices listed range the full gamut, including such things as checkbook templates and eye switches which can be used to operate computers. Custom searches are available for a fee through the National Rehabilitation Information Center (NARIC).

RehabData. Also operated by NARIC, this system is a database containing information about research funded by the National Institute of Handicapped Research and the Rehabilitation Services Administration and also contains articles, books, directories, and audiovisual materials on rehabilitation.

Other Systems

Accent on Information. Private, commercial system with information on 5,000 products, organizations, and resources on adapting or producing equipment.

Compendex. Technical engineering information which contains rehabilitation-related data.

National Technical Information Service (NTIS). Reports government-sponsored research, development and engineering technical activities.

Accessing Resources

This presentation has covered community based, research and innovation, and information systems resources. Accessing these resources varies considerably. The community based resources involve a search of locally available programs and services. Often it is difficult to find a single source which can provide all resources needed. The practicing engineer will likely have to contact several organizations in order to find the ones which are most helpful. Beginning points include local rehabilitation agencies, rehabilitation facilities, and independent living centers.

Accessing information from the research centers usually involves obtaining information directly from NIHR or from the

Figure 3

JAN - Job Accommodation Example

Nature of Disability:

Above the wrist amputation of left hand
(employee was left hand dominant)

Job Title and Description:

- Furnace charger--operate buttons on charge box with two hands to raise and lower charge buckets. Climb steps to top of furnace. Use rod to release wishbone.

Functional Limitations Accommodated:

Lifting
Carrying
Reaching
Grasping
Handling/Fingering
Pushing/Pulling

Solution/Modification:

Employee wanted to return to pre-injury job. An orthopedic appliance manufacturer was contacted to develop an appliance that would be sturdy enough to withstand the heat and dust as well as functional enough to operate the panel box. A duplicate of the panel box was provided for dimensions and operation. Eventually, an appliance was designed and the employee was able to perform his pre-injury job.

Accommodation Method:

Purchase of commercially developed device for $1,800.

Figure 4

JAN - Job Accommodation Example

Nature of Disability:

Deafness; retinitis pigmentosa (visual impairment)

Type of Job:

Data entry operator/backup computer operator--Input data for all functions of payroll, accounts payable, general ledger, job cost, equipment, and critical path and aids and fills in for computer operator.

Functional Limitations Accommodated:

Hearing
Talking
Reading

Solution/Modification:

Taught co-workers sign language as method of communication. Designed and printed input forms with sharp color contrasts to add to reading ease. Installed special switch outside of computer room which, when pushed, turns off light in computer room as a means of notifying the employee that a person seeks help or entry into the room.

Accommodation Method:

Adaptation to existing equipment with cost of $300.

center of interest. A listing of these resources is provided in the supplement to this presentation. Most organizations funded by federal sources are able to provide limited copies or reprints of their research at little or no cost. Many conduct training seminars for practitioners.

The information systems are accessed through telephone contacts, with some free and some charging fees for services. JAN is probably the most useful single source and operates currently as a free service. Access information is provided in the supplement.

Accommodations Incentives

There are several tangible incentives which can be utilized when accommodating workers with disabilities. The first is a tax credit which any employer is entitled to and is available through Federal income tax credits. Information on this may be obtained through any Internal Revenue Service Office, specifically through publication 904.

An additional incentive to the employer is the quality worker which can be obtained when a person with a disability is employed. Many workers with disabilities have been provided with rehabilitation services and are job ready. The performance quality of workers with disabilities is well documented through studies such as those conducted by du Pont. (1)

Finally, many employers are covered by Federal legislation which requires affirmative action programs for workers with disabilities. Accommodations make it possible to realize the employment of workers with disabilities and meet affirmative action requirements.

Bibliography

1. du Pont de Nemours & Company (1982). Equal to the task: 1981 du Pont survey of employment of the handicapped. Graphics Communication Division: Wilmington, DE.

Listing of Resources

The following lists are provided for the use of the reader in accessing additional information about accommodations and various resources covered in this presentation.

Rehabilitation Engineering Centers	Specialty Areas
Gallaudet College Division of Research 400 Florida Avenue, N.E. Washington, DC 20002	Rehabilitation Engineering Research for Deaf and Hearing Impaired
Smith Kettlewell Institute of Visual Sciences	Development and Evaluation of Sensory Aids for Blind

2200 Webster Street San Francisco, CA 94115	and Deaf Individuals
University of Virginia Medical Center Dept. of Orthopedics and Rehabilitation P.O. Box 159/UVA Charlottesville, VA 22908	Research and Development on Improved Wheelchair Systems and Specialized Seating
Project Staff Association, Inc. Rancho Los Amigos Hospital, Inc. 7413 Golondrinas Street Downey, CA 90242	Research on Functional Electrical Stimulation
Children's Hospital Medical Center Harvard-MIT Rehabilitation Engineering Center 300 Longwood Avenue Boston, MA 02115	Research on Quantification of Human Performance
Northwestern University Regional Engineering Center 633 Clark Street Evanston, IL 60201	Research on Prosthetics/ Orthotics
Cerebral Palsy Research Foundation of Kansas, Inc. 2021 North Old Manor Wichita, KS 67208	Research on Work Site Modification Using Technology Systems Approaches
University of Wisconsin System Board of Regents 750 University Avenue Madison, WI 53706	Research on Access to Central and Communication Information Processing Systems
Tufts New England Medical Center Dept. of Rehabilitation Medicine 171 Harrison Avenue Boston, MA 02111	Research on Non-Vocal Communication Systems
Dallas Rehabilitation Foundation 7850 Brookhollow Road Dallas, TX 75235	Research on Improved Method of Quantification of Human Performance
University of Minnesota Dept. of Physical Medicine and Rehabilitation c/o DRA 1919 University Avenue St. Paul, MN 55455	Research on Improved Method of Quantification of Human Performance
University of Vermont College of Medicine Burlington, VT 05405	Low Back Pain

The Lexington Center, Inc. 30th Avenue and 75th Street Jackson Heights, NY 11370	Development of New Generation Hearing Aids
Electronic Industries Foundation 2001 Eye Street, N.W. Suite 405 Washington, DC 20006	Stimulation of Industry and Evaluation of Technology
Southwest Research Institute Electronic Systems Division P.O. Drawer 28510 6220 Culebra Road San Antonio, TX 78284	Evaluation of Technology
Louisiana Tech University Department of Biomedical Engineering P.O. Box 7923T.3 Rustin, LA 72172	Research on Personal Licensed Vehicles
Rehabilitation Institute/ Ljubljana, Dept. O Lushartova 51/61000 Ljubljana, Yugoslavia 00000	Research on Functional Electrical Stimulation

Research and Training Centers	Specialty Areas
Baylor College of Medicine Department of Rehabilitation 1200 Moursund Avenue Houston, TX 77030	Research and Training Center for the Rehabilitation of Persons with Spinal Cord Dysfunction
Boston University Sargent Colonel of Allied Health 881 Commonwealth Avenue Boston, MA 02215	Improvement of Rehabilitation Outcomes of Individuals with Mental Illness
Yeshiva University/Einstein College of Medicine 1300 Morris Park Avenue Bronx, NY 10461	Research on Rehabilitation Management of Patients with Neuromuscular Diseases including Multiple Sclerosis
Emory University School of Medicine 1441 Clifton Road, N.E. Atlanta, GA 30322	Research and Training Center in Brain Trauma
George Washington University Office of Sponsored Research Rice Hall, Sixth Floor Washington, DC 20052	Improving the Psychosocial Environment and Eliminating Social and Attitudinal Barriers
Human Resources Center I.U. Willets Road Albertson, NY 11507	Research on Employability of Handicapped Individuals

Mississippi State University P.O. Drawer LQ Mississippi State, MS 39762	Research and Training Center in Blindness and Low Vision Rehabilitation
NY University Medical Center School of Medicine 550 First Avenue New York, NY 10016	Research and Training Center on Brain Trauma and Stroke
NY University Medical Center School of Medicine 550 First Avenue New York, NY 10016	Research on Management of Neuromuscular Disease
Northern Arizona University Institute of Human Development C.U. Box 5630 Flagstaff, AZ 86011	Native American Rehabilitation Research and Training Center
University of Arizona Dept. of Speech & Hearing Sciences Tucson, AZ 85721	Native American Rehabilitation Research and Training Center
Northwestern University Dept. of Rehabilitation Medicine 633 Clark Street Evanston, IL 60201	Research and Training Center on Brain Trauma and Stroke
Professional Staff Association of Rancho Los Amigos Hospital 7448 Golondrinas Street Downey, CA 90242	Multidisciplinary Research Approach in the Assessment and Rehabilitation of Elderly Handicapped Persons
The Menninger Foundation 700 Jackson, 9th Floor Topeka, KS 66603	Research and Training Center to Improve Vocational Rehabilitation at the Worksite and Increase Employment of Severely Disabled Individuals
Tufts-New England Medical Center Dept. of Rehabilitation Medicine 171 Harrison Avenue Boston, MA 02111	Musculoskeletal Disorders in Children and Adults, Including Arthritis
University of Alabama/Birmingham Dept. of Rehabilitation Medicine University Station Birmingham, AL 35294	Research and Training Center in Spinal Cord Dysfunction
University of Arkansas Research & Training Center in Vocational Rehabilitation 346 N. West Avenue Fayetteville, AR 72701	Research on Vocational Aspects of Rehabilitation: Enhancing Employability of Handicapped Persons

University of Arkansas R&T Center for Deafness/ Hearing Impairment 4601 W. Markham Little Rock, AR 72205	Vocational Rehabilitation of Individuals with Deafness and Hearing Impairments
University of California/Davis Office of Research 275 MRAK Hall Davis, CA 95616	Research on Management of Neuromuscular Disease Problems Including Multiple Sclerosis
Univ. of California/Los Angeles 504 Hilgard Avenue Los Angeles, CA 90024	Rehabilitation of Chronic Psychiatrically Disabled Individuals
Univ. of California/San Francisco Center on Deafness 1474 Fifth Avenue San Francisco, CA 94143	Research and Training Center for the Study of Psychological and Linguistic Aspects of Deafness
University of Colorado Health Sciences Center 4200 East 9th Avenue Box C242 Denver, CO 80262	Research and Training Center in Cardiac Rehabilitation
University of Kansas Bureau of Child Research 223 Haworth Lawrence, KS 66045	Enhancement of Independent Living Services
Univ. of Oregon Graduate School R&T Center in Mental Retardation Eugene, OR 97403	Research on Development of Diagnostic Instruments Designed to Measure Adaptive Behavior of Mentally Retarded Persons
University of Pennsylvania School of Medicine Dept. of PM&R 3451 Walnut Street Philadelphia, PA 19104	Psychosocial and Medical Rehabilitation of Elderly Handicapped Individuals
University of Virginia Dept. of Orthopedics and Rehabilitation Box 159, UVA Medical Center Charlottesville, VA 22908	Research and Training Center on Improved Modalities for Musculoskeletal Arthritis and Low Back Pain
University of Washington Dept. of Rehabilitation Medicine BB919 Health Sciences Bldg. Seattle, WA 98195	Rehabilitation in Brain Trauma and Stroke

University of Wisconsin/Madison Board of Regents 750 University Avenue Madison, WI 53706	Research and Training Center in Community Integration of Mentally Retarded Persons
University of Wisconsin/Stout Stout Vocational Rehabilitation Institute Menomonie, WI 54751	Research on Sheltered Transitional Employment
Research & Training Center in Mental Retardation Virginia Commonwealth University 1045 Oliver Hall Richmond, VA 23284	Improving Employability of Mentally Retarded Individuals
Vocational Rehabilitation Research and Training Center West Virginia University Morgantown, WV 26506	Improving Management of Vocational Rehabilitation Services

Information Systems

Job Accommodation Network President's Committee on Employment of the Handicapped P.O. Box 468 Morgantown, WV 26505	Ph. (800) JAN-PCEH
ABLEDATA National Rehabilitation Information Center 4407 8th Street, N.E. Washington, DC 20017	Ph. (202) 635-5822 voice (202) 635-5884 TDD
REHABDATA National Rehabilitation Information Center 4407 8th Street, N.E. Washington, DC 20017	Ph. (202) 635-5822 voice (202) 635-5884 TDD
Accent on Information P.O. Box 700 Bloomington, IL 61701	
National Technical Information Service (NTIS) 425 13th Street, N.W. Washington, DC 20004	Ph. (202) 487-4600
COMPENDEX Engineering Index, Inc. 345 E. 47th Street New York, NY 10017	Ph. (800) 221-1044 (202) 644-7600